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GB 0718301
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(54) Roof purlin

(57) A steel, cold rolled, roofing purlin which has a top web (12) projecting to one side of a main web (16) and two bottom webs (20, 22) projecting to opposite sides of the main web, thereby to assume the general form of a letter J, said purlin having its second lower web (22) formed by turning back the first lower web (21) beneath itself, wherein a hollow lip (21 or 26) of uniform cross section along the length of the purlin at the turned back edge of the first lower web (21) is formed.

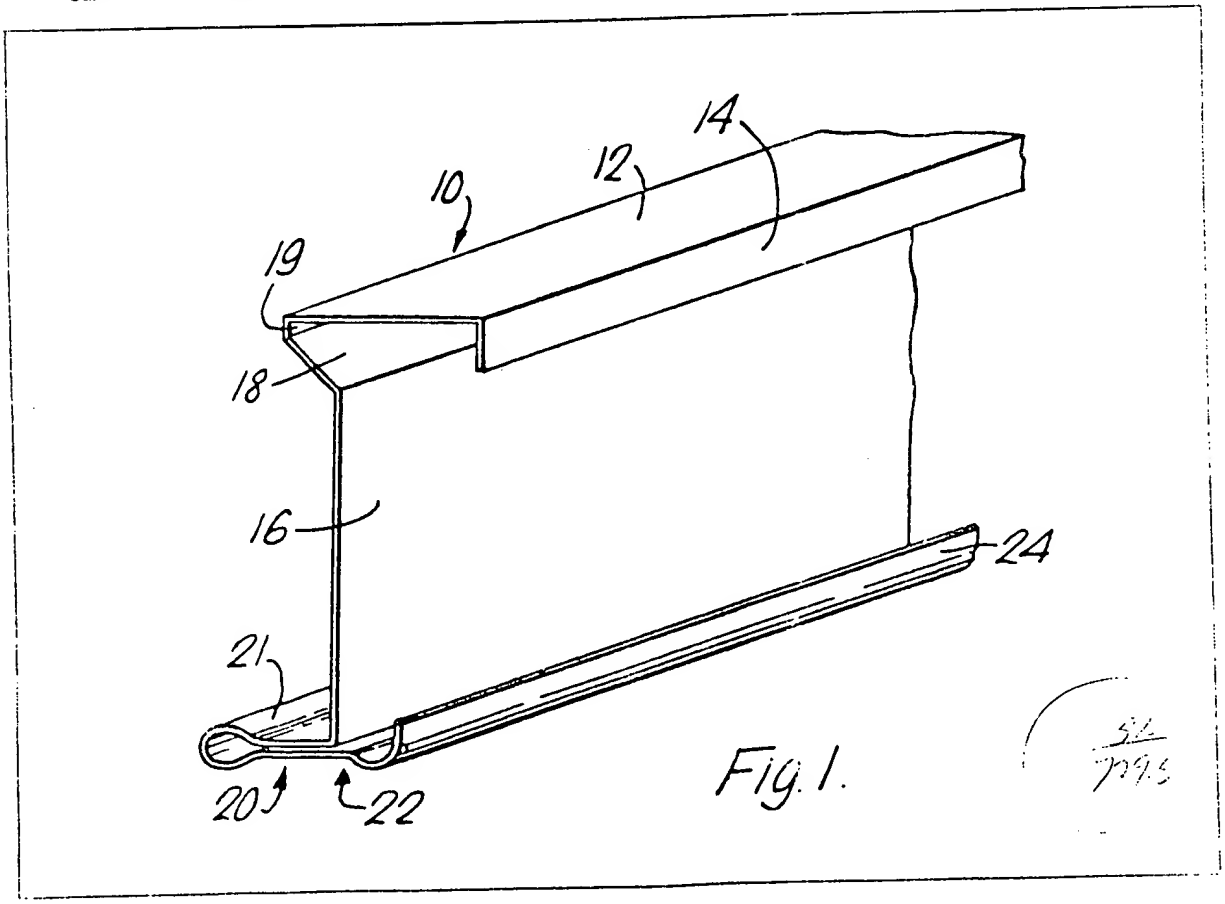

Fig. 1.

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Fig. 1.

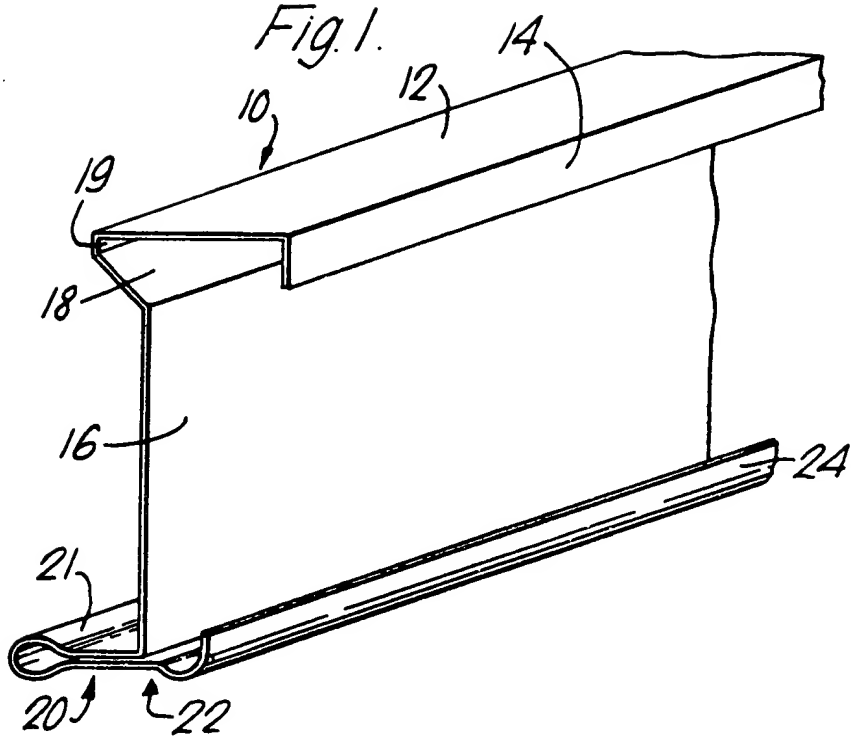


Fig. 2

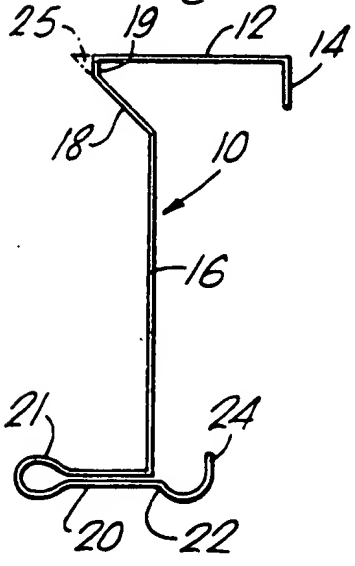


Fig. 3.

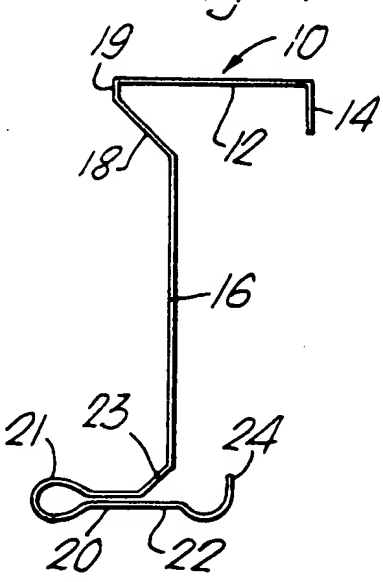


Fig. 4.

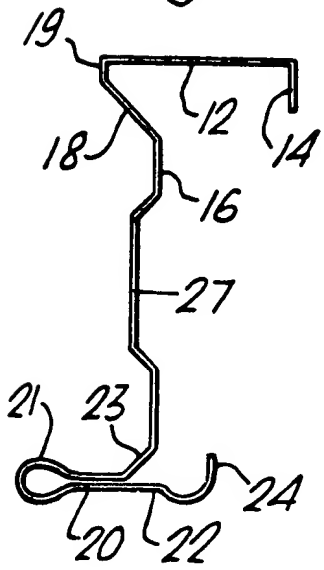
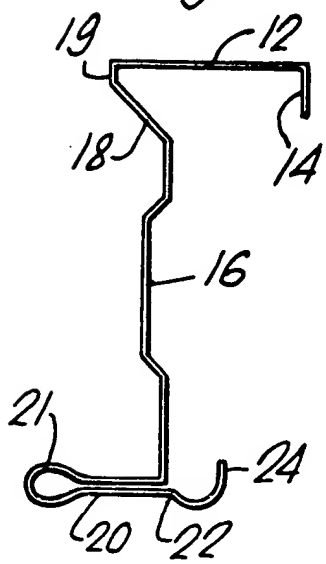


Fig. 5.



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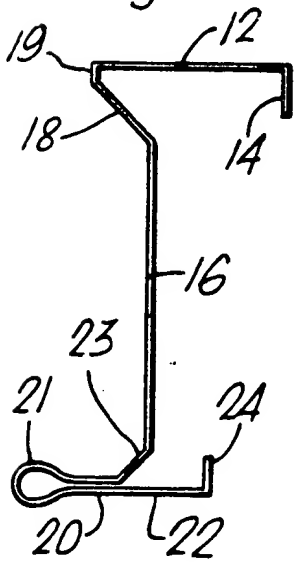

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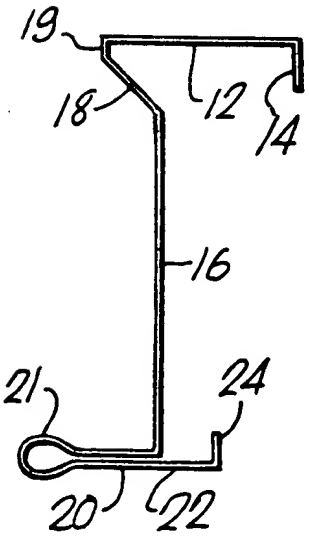

Fig. 8.

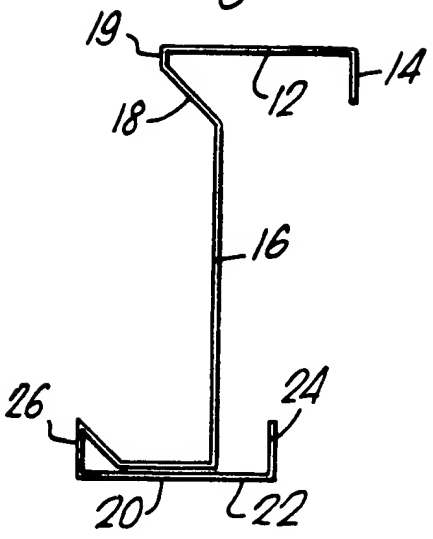

Fig. 9.

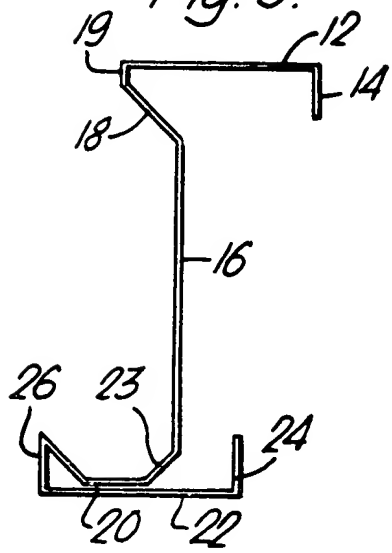

Fig. 10.

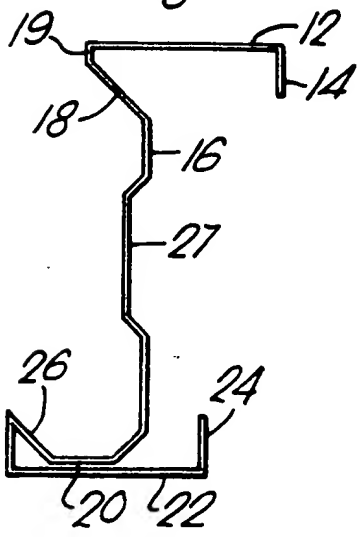

Fig. 11.

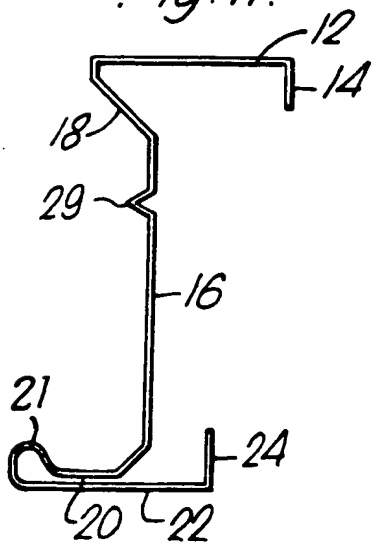

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Fig. 12.

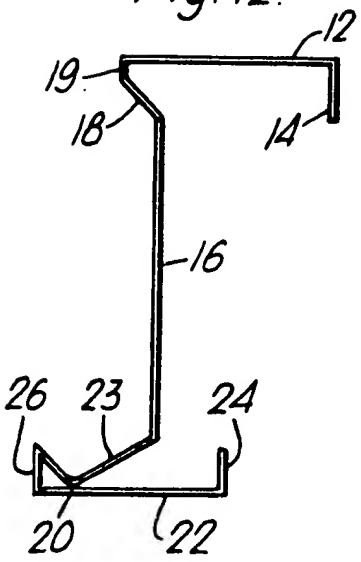


Fig. 13.

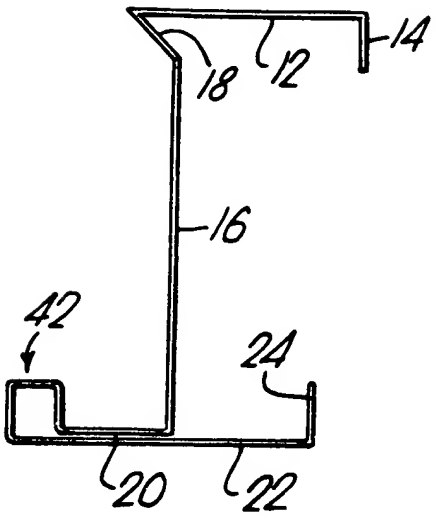


Fig. 14.

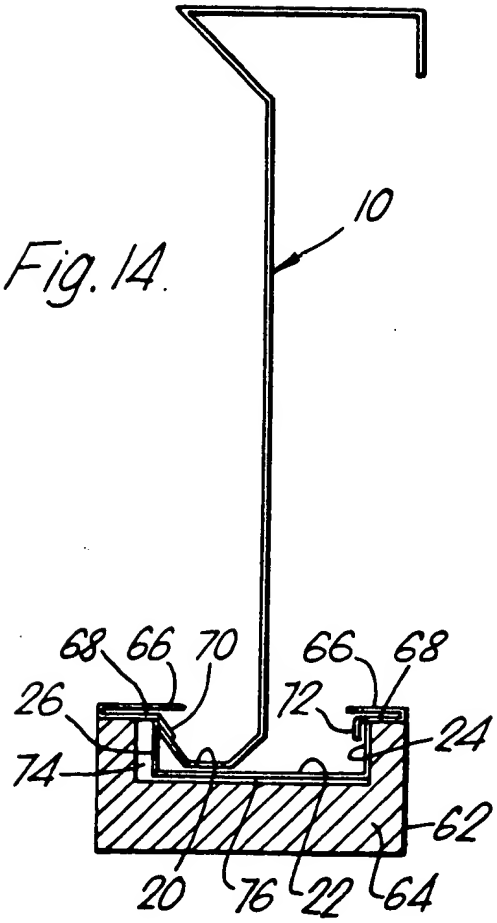
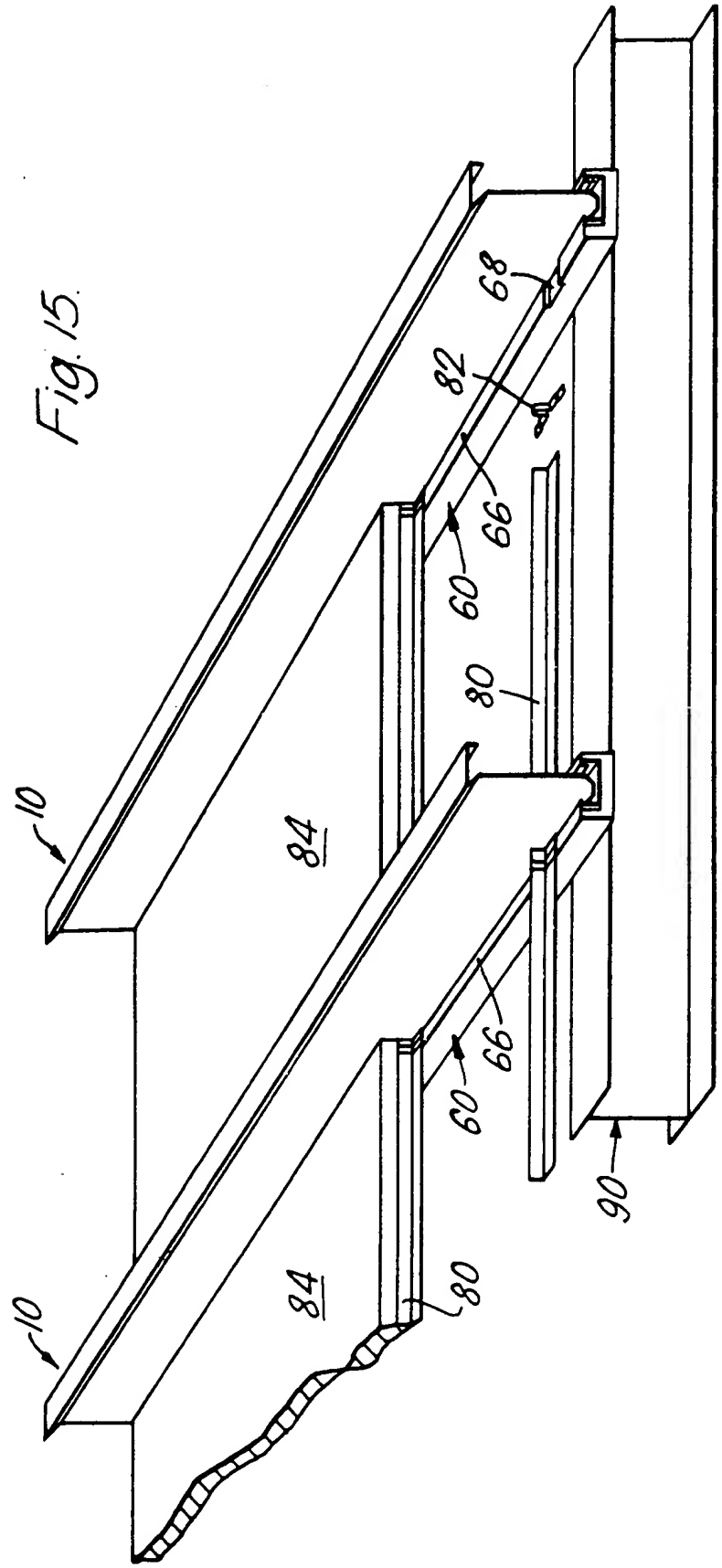


Fig. 15



SPECIFICATION
Roofing purlin

This invention relates to a roofing purlin, to a roofing system in which such purlins are incorporated, and to a purlin sub-assembly employed in such roofing system.

Conventionally, roofs for large industrial, commercial and agricultural buildings are based on steel Z-purlins, i.e. purlins produced by cold rolling and having a top web projecting laterally to one side of the main web and a bottom web projecting laterally to the opposite side of the main web. Outer roofing sheets are mounted over the purlins, conventionally being secured down to the top webs thereof by hooked bolts which make hooked engagement with depending lips formed on such top webs. Heat insulation may be incorporated directly under the outer roofing sheets, with the disadvantage when high standards of insulation are specified of requiring longer stemmed fixing bolts which lead to instability. Furthermore, it is sometimes difficult, with an over-purlin arrangement, to avoid the existence of a cold bridge providing a heat conductive path from the warm space below the insulating layer to the cold space above it and this, apart from being energy wasteful, can lead to condensation problems. Alternatively, heat insulation may be incorporated in an inner roofing layer suspended below the bottom webs of the purlins. The latter under-purlin insulating arrangement is disadvantageous in cost and complexity. This is because a relatively complicated mechanical suspension system is required to provide a continuous insulating layer beneath the purlins, the complexity of which is accentuated by the fact that the bottom webs of the purlins project to one side only.

In an endeavour to meet the above problems, my copending U.K. Patent Application No. 8033274 describes a heat insulating roofing system wherein an inner roofing layer incorporating heat insulation is mounted directly between the purlins. One embodiment of purlin incorporated in such an inter-purlin insulating arrangement is an inverted J-purlin, i.e. a purlin having two bottom webs respectively projecting laterally to opposite sides of the main web. A disadvantage of this J-purlin, as illustrated and described, lies in its physical weakness in the region of the bottom webs. This results from the fact that the second web is formed by folding back the first web beneath itself through a single fold of 180 degrees. In addition, the illustrated and described J-purlin, as applied in my copending application No. 8033274, is not quite as convenient to use, as compared for example with the Z-purlin arrangement which is also illustrated and described, primarily because it often necessitates the use of a two part insulating sleeve assembly, which, as described in said copending application, is used to break the above-mentioned cold bridge.

It is an object of the present invention to provide further improvements in steel, cold rolled J-purlins.

In accordance with one aspect of the present invention, there is provided a steel, cold rolled roofing purlin comprising, in the orientation in which it is intended for use, a main web extending between an upper web projecting laterally to one side of the main web and lower webs projecting respectively to opposite sides of the main web, said lower webs being constituted on one side of the main web by a first lower web which is turned back beneath itself to project to the other side of the main web and thereby form the second lower web, wherein the turned back edge portion of the first lower web is in the form of a lip of uniform, hollow cross section along the length of the purlin, the two layers of said first lower web being in closely adjacent relationship at the inner longitudinal boundary or edge of the hollow lip.

The two layers of the first lower web are preferably in closely adjacent, parallel relationship over at least a part of the overall width of said lower web between the main web and the remote, outer boundary or edge of the hollow lip. Said part is desirably at least one third of the overall width.

In two arrangements, the hollow lip is formed by turning back the first lower web in stages, thereby to produce a hollow lip upstanding from the first lower web to the same level as a simple, planar lip upstanding parallel to the main web from the edge of the second lower web. Such hollow lip thus constitutes an upstanding edge portion, which may comprise a single fold in one sense with an internal angle of 90 degrees and three folds in the reverse sense each with an internal angle of 90 degrees, thereby forming a hollow, generally square-sectioned lip, but in a preferred arrangement comprises a single fold in one sense with an internal angle of about 135 degrees, followed by two folds in the reverse sense one with an internal angle of about 45 degrees and one with an internal angle of 90 degrees, thereby forming a hollow, generally triangle-sectioned lip. The first two mentioned angles in the preferred arrangement are exemplary only: however it is important to avoid any internal angle less than about 30 degrees in order to prevent development of structural weakness in the region of the fold during the cold rolling production process.

The folding back of the first lower web can alternatively be effected by turning it through a smooth curve of radius substantially greater than the thickness of the steel sheet from which the purlin is produced. Thus, the first lower web is first turned upwardly through an acute angle, say about 45 degrees, and then smoothly turned in the reverse sense through an angle greater than 180 degrees, say about 270 degrees. Preferably, this brings the turned back edge to a level below that of the first lower web, and it is therefore again turned in the first sense through an acute angle, say about 45 degrees, to complete a turn of 180 degrees around the hollow lip. The cross section of such hollow lip may thus vary from a

desired, by a non-symmetrical smooth turning back of the first lower web 20 such that the lip 21 does not project below the level of said web. An example of such a purlin is shown in Figure 11, wherein it will be noted that although a smoothly turned back, hollow lip 21 is provided on the first lower web 20, the underside of the purlin is flat, the planar lip 24 on the second lower web 21 being formed by a simple right-angled fold. Thus, both the hollow lip 21 and the planar lip 24 only project above the level of the plane of the lower webs 20, 22. As before, such two lips 21 and 24 desirably project to the same level relative to the main web 16, which includes top and bottom angled portions 18 and 23, although the connecting portion 19 is omitted. More importantly, the main web 16 of the purlin of Figure 11 has a preferred form of reinforcing rib 29 generally of V shape, located about one fifth of the distance down the main web from the upper web 12 to the lower webs 20, 22.

The purlin of Figure 11 is a particularly preferred form of J-purlin, convenient for production by cold rolling and of high rigidity and strength in all parts when so produced by cold rolling.

Another practical but less preferred purlin is shown in Figure 12. This differs from the purlin of Figure 9 in that the bottom angled portion 23 of the main web meets the first lower web 20 at the inner edge or boundary of the triangularly sectioned, hollow lip 26. Thus the two layers of the first lower web 20 are in closely adjacent relationship only at said inner edge of the lip 26.

Another modification of J-purlin is shown in Figure 13, wherein an upstanding hollow edge portion or lip 42 of the first lower web 20 is a hollow square cross-section, being defined by four folds, one in one sense and three in the opposite sense, each with an internal or included angle of 90 degrees. In other respects, the purlin of Figure 13 has features similar to those of the purlins previously described.

The purlin 10 of this invention is intended for use in a heat insulating roofing system, in a manner analogous to that described in my copending Application No. 8033274. This manner of use will now be briefly repeated.

First, a one-part heat-insulating sleeve assembly 60 is secured to the bottom of a purlin 10, such as the purlin of Figure 9 with omission of the portion 19, as shown in Figure 14. The J-purlin of this invention enables the sleeve assembly 60 to be assembled to the purlin in the confines of the roof space, and not be pre-assembled therewith before the purlin is raised and fixed in position to the roof stanchions. Also the preferred J-purlin 10 enables the securing of the sleeve assembly 60 without drilling or other difficult fixing techniques in the environment of the roof space.

Thus, the sleeve assembly 60 comprises a rigid, metal outer U-sleeve 62 housing a U-shaped filler 64 of heat insulating material. The outer sleeve 62 has inturned flanges 66 covering the tops of the limbs of the filler 64. The flanges 66 have partly-severed, depressed tabs 68, spaced apart along the length of the sleeve assembly. Each tab 68 has its end edge turned downwardly towards the base of the sleeve, as indicated at 70 on one side and 72 on the other side.

The sleeve 62 and its filler 64 are transversely dimensioned, relatively to the width of the bottom of the purlin 10, to enable the tab ends 70 of the sleeve assembly 60 to be hooked over the hollow lip 26 of the first lower web 20, temporarily to provide sole support for the sleeve assembly. The sleeve assembly 60 can then be swung upwardly towards the undersurface of the purlin 10, and with the dimensional tolerance 74 transferred to the opposite side (right-hand side in Figure 14) the tab ends 72 can be hooked over the upturned lip 24 of the second lower web 22. When the dimensional tolerance 74 is then transferred to the side of said hollow lip 26 (left-hand side in Figure 14), the sleeve assembly 60 is effectively secured in position. In practice, in a pitched roof, the purlin 10 will be fixed with its top web 12 pointing towards the ridge, so that the dimensional tolerance 74 always tends to remain on the side of the hollow lip 26. The inclination of the tab ends 70, matching the slope of the inwardly directed face of the hollow lip 26 is also apparent from Figure 14, as is the residual clearance 76 which is left between the base of the filler 74 and the undersurface of the purlin 10.

Although illustrated and described with particular reference to the purlin of Figure 9, the above described procedure is equally applicable to any of the other embodiments of J-purlin described herein. Accordingly, the unit or sub-assembly of the purlin 10 of any of Figures 1 to 13, in combination with the sleeve assembly 60 described with reference to Figure 14, constitutes an important aspect of the present invention.

Figure 15 shows the basic elements of a roof structure incorporating the above-described purlins 10 with sleeve assemblies 60 secured around the bottom webs thereof. Reference 90 denotes one of a number of roof stanchions to which the purlins are fixed. Inverted tee-bars 90 are bridged between the purlins, seating for locating purposes in the recesses provided by the partly-severed, depressed tabs 68 in the flanges 66 of the outer sleeves 62 of the sleeve assemblies. Retaining clips 82 hold the tee-bars down in their located positions. Sheets 84 of heat-insulating fire-retardant material are then laid in the rectangularly-framed trays formed by the grid of purlins 10 and tee-bars 80. The outer roof (not shown) is provided by weatherproof roofing sheets fixed to the top webs 12 of the purlins 10. Either conventional hooked bolts can be employed, these making hooking engagement with the downturned flanges 14 of the purlin top webs 12, or direct fixing by self-tapping screws can be used to fix the outer roofing sheets.

The purlins 10 thus serve a dual purpose, the first the conventional one of fixing the outer roofing sheets, and the second the additional

purpose of directly supporting a heat insulating inner roofing layer. In contradistinction to known inner roofing systems, the heat insulation is supported in an inter-purlin arrangement, in contrast to an arrangement suspended beneath the purlins. This is readily made possible firstly by the above-described construction of J-purlin, which has adequate strength, especially resistance to twist, to support such an inter-purlin arrangement, and secondly by the ready manner of securing the insulating sleeve assemblies in position to the bottoms of the purlins, as is necessary to break the cold bridge which could otherwise lead to heat conduction from the warm, moist building space below the insulation to the cold space above it.

It will be appreciated that various modifications of the described arrangements are possible, and that the invention is intended to embrace all such modifications encompassed within the scope of the invention as hereinbefore defined.

CLAIMS

1. A steel, cold rolled, roofing purlin comprising, in the orientation in which it is intended for use, a main web extending between an upper web projecting laterally to one side of said main web and lower webs projecting laterally respectively to opposite sides of the main web, wherein the first lower web extends laterally to one side from the main web and is folded back beneath itself to extend laterally to the other side of the main web to form the second lower web, and wherein the folded back outer longitudinal edge portion of the first lower web comprises a lip of uniform, hollow cross section along the length of the purlin, the two layers of the first lower web being in closely adjacent relationship at the inner longitudinal edge of said lip.

2. A purlin according to claim 1, wherein the second lower web has an upturned planar lip and the hollow lip on the first lower web projects upwardly relative to the main web to the same level as said upturned planar lip.

3. A purlin according to claim 1 or claim 2, wherein the lip on the first lower web has a hollow, rounded cross section.

4. A purlin according to claim 1 or claim 2, wherein the lip on the first lower web has a hollow, polygonal cross section.

5. A purlin according to any of claims 1 to 4, wherein the main web includes an inclined portion through which it is connected to the upper web.

6. A purlin according to any of claims 1 to 5, wherein the main web includes an inclined portion through which it is connected to the first lower web.

7. A purlin according to any of claims 1 to 6, having a reinforcing rib in the main web.

8. A purlin according to claim 7, wherein said reinforcing rib is a V-shaped rib located about one fifth of the distance down the main web from the upper web towards the lower webs.

9. A purlin according to any of claims 1 to 8, in combination with a U-shaped heat insulating sleeve assembly mounted to the lower webs thereof.

10. The combination according to claim 9, wherein the U-shaped assembly includes an arrangement of hooked tabs on each side, and is dimensioned to enable said sleeve assembly to be first hooked to one lower web, laterally displaced, hooked to the other lower web and then oppositely displaced laterally to secure the assembly to the purlin.

11. A roof structure incorporating spaced, parallel purlin and sleeve combinations according to claim 9 or claim 10, crosspieces bridging the purlins and seating on the insulating sleeve assemblies, and heat insulating roofing panels laid in the rectangular frames defined by the grid of purlins and crosspieces.

12. A roofing purlin substantially as hereinbefore described with reference to any of Figures 1 to 13 of the accompanying drawings.

13. A purlin/insulation sleeve combination substantially as hereinbefore described with reference to Figure 14 of the accompanying drawings.

14. An insulating roof structure substantially as hereinbefore described with reference to Figure 15 of the accompanying drawings.

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